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Patent Bulletin

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Specification

1. Title of Invention

A method to produce light weight forms.

2. Claims

A method to manufacture light weight forms in which a lime material, water glass, and a silicate substance are added to sludge from a water purification plant and the mixture is subjected to a hydrothermal reaction in the presence of water for forming.

3. Detailed Description of the Invention

The present invention concerns an effective method to produce light weight forms by utilizing sludge that is generated at a water purification plant.

Light weight forms that were used for insulating materials and light weight construction materials are composed of calcium silicate (Tobamolite), which is manufactured from lime and quartz sand. These light weight forms are consumed in large quantities and it is essential that they be inexpensive. However, the material is derived from natural sources, as noted above, and it is difficult to reduce the manufacturing cost further.

Meanwhile a large quantity of sludge is generated at water purifying plants and with the stepped-up urbanization process, its disposal, such as procuring disposal sites, is becoming increasingly difficult.

This invention is intended to offer an effective use of sludge that is produced at water purifying plants, as well as to present an inexpensive light weight form. Specifically, this invention offers a method in which a calcareous substance, water glass, and silicate material are added to sludge obtained from water purifying plants. The mixture undergoes a hydrothermic reaction in the presence of water, then is formed into the desired shape.

The design of this invention is presented below in detail.

The sludge used in this invention is generated when waste water is processed at a water purifying plant. It is in varied forms, such as dehydrated cakes, slurries from condensation vats, and desiccated products. These slurries generally contain 20 to 30 weight % of alumina and 5 to 10 weight % of iron oxide.

The calcareous substance used in this invention is burnt lime (CaO) or calcium hydroxide (Ca(OH)_2). Water glass is an aqueous solution of sodium silicate: commercially produced water glass No. 3 is desirable for use in this invention. Examples of silicates include quartz sand.

As stated earlier, calcium silicate (Tobamolite) can be produced through a reaction between lime and quartz sand. If lime, quartz sand, and the aforementioned sludge from a water purifying plant are used in this instance, however, the alumina and iron oxide fractions in these ingredients may undergo a side reaction through an interaction between the lime and quartz sand, thus interfering with the satisfactory formation of calcium silicate crystals. To eliminate this effect, water glass is used in this invention. After a concentrated study, this innovation was added when the inventors discovered that the addition of water glass markedly reduced this interference by alumina or iron oxide and enhanced the formation of calcium silicate crystals. This feature is evident in the attached drawing, which shows the effect of the addition of water glass on the bulk density of the product.

The present invention describes a method in which a calcareous substance, water glass, and a silicate material are added to sludge obtained from a water purifying plant; and their composition undergoes a hydrothermic reaction in the presence of water. In this process, the amounts of the ingredients are not specified but the following have been found to be satisfactory: 30 to 50 weight parts of a calcareous substance, 10 to 90 weight parts of water glass (preferably water glass No. 3), and 5 to 20 weight parts of a silicate substance, all to 70 weight parts (dry standard) of slurry from a water purifying plant. Tenfold the weight of the solid materials should be sufficient for the quantity of water that is added. The quantity of water glass varies according to the amount of the calcareous substance but the optimum quantity for water glass No. 3 ranges from 40 to 65 weight parts. When a slurry obtained directly from a condensation vat is used, it may be subjected to a preliminary treatment, in which the material is heated at a temperature above 130°C for 30 minutes for bubbling in the presence of water in a quantity at least 4 times the weight of the solid; then water is added to the composition so that it will be more than 10 times that of the solid weight. When dried and pulverized sludge is used, the aforementioned bubbling process is not needed and the quantity of water to be added is simply adjusted to be over 10 times that of the solid weight. The hydrothermic reaction may be allowed to take place in an autoclave while the ingredients are being agitated. The optimum

temperature for this reaction is over 170°C or preferably around 180°C; and the time of the same reaction is over 4 hours or preferably around 8 hours. The reaction product "as is" or reinforced by fibrous substances, such as asbestos or glass fibers, is processed into the desired form. After molding, it is dried at a temperature above 100°C.

Examples of this invention are presented below.

Example 1.

The following ingredients underwent a hydrothermic reaction in an autoclave set at 180°C for 8 hours: 80 weight parts (dry standard) of sludge from a condensation vat, 50 weight parts of burnt lime, 10 weight parts of quartz sand, 27 weight parts of water glass No. 3, and 2,800 weight parts of water. The reaction product was subjected to a pressure of 15 kg/cm² for molding. A light weight molded product with a bulk density of 0.35 was obtained.

Example 2.

Sludge obtained from a condensation vat was dried at 450°C and pulverized in a ceramic pot mill for 15 hours. To 70 weight parts (dry standard) of this sludge, 40 weight parts of burnt lime, 10 weight parts of quartz sand, 40 weight parts of water glass No. 3, and 2,400 weight parts of water were added. The composition was mixed and allowed to undergo a hydrothermic reaction for 8 hours in an autoclave at 180°C. The reaction product was subjected to a pressure of 15 kg/cm² for molding. A light weight molded form with a bulk density of 0.25 was obtained.

Example 3.

Sludge from a condensation vat was dried at 450°C and pulverized in a ceramic pot mill for 10 hours. Seventy weight parts (dry standard) of this sludge, 40 weight parts of burnt lime, 10 weight parts of quartz sand, 65 weight parts of water glass No. 3, and 2,500 weight parts of water underwent a hydrothermic process at 180°C in an autoclave for 4 hours. The reaction product was combined with 10 weight parts of asbestos. Pressure of 15 kg/cm² was applied for molding to obtain a light weight molded substance having a bulk density of 0.30.

4. Brief Description of the Drawing

A graph showing the effect of the addition of water glass on the bulk density of the molded product.

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1. bulk density of the molded product (g/cm³)

2. water glass/(lime + quartz sand) (ml/g)